

Effect of Different Shade House on Quality Seedling Raising of High Value Vegetables

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Abstract

An experiment was undertaken to identify suitable shade house for different high value vegetables during the winter season of 2019-20 at the research farm of Olericulture Division, HRC, BARI, Gazipur. The experiment was randomized complete block design with 3 replications. Four vegetable varieties viz., tomato (V1), brinjal (V2), capsicum (V3), broccoli (V4) and 4 shading treatments [1) UV stabilized polyethylene film with 60 mesh insect net along with green shade net (T1); 2) UV stabilized polyethylene film with 60 mesh insect net (T2); 3) 60 mesh insect net (T3) and 4) Open field (control) (T4)] were included in this study. Different vegetables responded differently with the changes of shade house irrespective of different characters. Brinjal (V2) resulted in the maximum seed germination (93.58%) with the lowest mortality (5.58%), in case of shading treatment, UV stabilized polyethylene film with 60 mesh insect net along with green shade net (T1) exhibited the maximum seed germination (94.83%) with lower mortality (3.33%). In case of combined effect, maximum seed germination (93.58%) and the lowest mortality (2.08%) were observed in V2T1. The tallest seedlings were produced in V3T1 at every growth stage (15 days, 20 days, 25 days, 30 days). The maximum no. of leaves was produced in V3T2. The minimum insect infestation was observed in V1T1, V1T2, V2T1, V2T2, V3T1, V3T2, V4T1, V4T2 (0.67% at 15 days and 20 days).

Keywords

Seedling, Shade House, Vegetables

1. Introduction

Vegetables are an important source of food and nutrition. But in Bangladesh

vegetable production is much less than the requirement if balanced diet is provided to every individual. The present production of 4.3 million tones is to be raised to 13 million tones [1]. There are different ways and means to achieve this target, e.g., bringing additional area under vegetable crops, using hybrid seeds, use of improved agro-techniques. Another potential approach is perfection and promotion of protected cultivation of vegetables [2]. During rainy summer season, the temperature and solar radiations are adverse for growing off-season vegetables: tomato, capsicum, brinjal, cauliflower, broccoli, lettuce, cucumber, squash, netted melon, water melon. Hence, during extreme conditions of weather, these high value vegetables can be well cultivated under protected cultivation structures year-round. Research results have shown that by adopting protected cultivation, productivity of high value vegetable crops can be increased by 3 to 5 times as compared to open environment. Green house, polyhouse, shade net house & low tunnels are the different types of protected cultivation structures commonly adopted by the farmers of developed country.

Quality seedling production is a sector having recently started growing in Bangladesh. Cultivation from seedlings has many advantageous opportunities, such as earlier harvest, utilization of time, economization of land, energy, and seeds, healthy and homogenous production, and warning process for earliness. In order to benefit from these advantages, producers have tended to production not from seeds, but from seedlings, thus increasing their demands for the seedlings of various vegetables. Cultivation from seedlings is much more important in congenial production. Use of vigorous seedlings provides solutions to the worrisome problems of the producers. In order to cultivate healthy seedlings, growing condition is as important as the ecological conditions. Various plant growing and dose studies are emphasized in the conducted researches. Efforts should be escalated for establishing and expanding growing condition, in compliance with the regulations on the production of quality vegetable seedlings, as being an important criterion. It is intended with this study to examine the quality features of the seedlings of the tomatoes and peppers, being produced in different growing conditions so as to be utilized in protected production to develop quality vegetable seedlings.

Shadenet house is a framed structure made of materials such as GI pipes, angle iron, wood or bamboo. It is covered with plastics nets which are made of 100% Polyethylene thread with specialized UV treatment having different shade percentages. It provides partially controlled atmosphere and environment by reducing light intensity and effective heat during day time to crops grown under it. Hence round the year seasonal and off-season cultivation is possible. Shading nets are used in tropical and subtropical countries for vegetable production [3] [4] [5]. Shading also reduces water requirements and increases irrigation water use efficiency in vegetable crops [6]. Poly house is a framed structure having 200 micron (800 gauges) UV stabilized transparent or translucent low density polyethylene which creates greenhouse effect making microclimate favorable for

plant growth and development. Structure is large enough to permit a person to work inside. Poly film layer placed beneath shade net (around 1 m below shadenet) which increases the temperature during winter & reduces during the summer season. This structure also aims at protect crop from devastating rains. Net house concept of protected house is a concept for protecting the insect. In well framed structure made up of GI pipes covered with 60 mesh nets.

To date, there is not much work available on protected cultivation of quality vegetables seedling production in Bangladesh condition. There is an urgent need to assess the quality vegetables seedling production and suitability for different vegetables under protected cultivation structures to meet the growing demand of the vegetables. Thus, the investigation was aimed to determine the efficacy of protected cultivation compared to open field on temperature and water requirement of vegetables during winter season. Since the selected crops viz., tomato, brinjal, capsicum, and broccoli are high value vegetables in Bangladesh that is why these vegetables are selected for these types of protected house to get quality seedlings. In this investigation an attempt is made to estimate the best protected cultivation structures for growing quality vegetables seedling production in Bangladesh condition. Keeping in view, the present study was formulated to select the suitable shade house for quality seedling raising of high value vegetables in Bangladesh.

2. Materials and Methods

2.1. Experimental Site

The experiment was designed at the research field of the Olericulture Division, HRC, BARI, Gazipur during November to December, 2019. The field was at 23.9920°N Latitude and 90.4125°E Longitudes having an elevation of 8.2 m from sea level under agro-ecological zone (AEZ) 28 (Annon, 1995). The farm was situated in the sub-tropical climatic zone and characterized by scanty rainfall during the experimental time.

2.2. Treatments and Raising of Plant Materials

Four vegetables varieties viz., tomato (V1), brinjal (V2), capsicum (V3), broccoli (V4) and 4 shading treatments [1) UV stabilized polyethylene film with 60 mesh insect net along with green shade net (T1); 2) UV stabilized polyethylene film with 60 mesh insect net (T2); 3) 60 mesh insect net (T3) and 4) Open field (control) (T4)] were included in this study. Total 16 treatment combinations were laid out in factorial design with three replications. Four types of vegetables were sown on polypot (12 cm × 10 cm) with fungicide treated seed on 15 November 2019 under four type of shading treatments. The polypots were filled up with fine sandy-loam soil and organic manure with 50:50 ratio. Different cultural operations such as irrigation, weeding, mulching etc. were done as and when needed.

2.3. Air Temperatures and Relative Humidity of the Experimental Area

Average monthly maximal and minimal air temperatures during the season in different structures are shown in **Table 1** & **Table 2**. **Table 1**, while **Table 3** shows the average relative humidity.

Table 1. Average monthly minimum temperature recorded in different protected cultivation structures for winter season.

Treatment	Minimum air temperature (°F)				
	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mean
UV stabilized polyethylene film with 60 mesh insect net along with green shade net	21.5	16	14.5	17.5	17.38
UV stabilized polyethylene film with 60 mesh insect net	23	18.5	16.5	19.5	19.38
60 mesh insect net	20	15	13.5	16	16.13
Open (control)	19	14	12.5	15	15.13

Table 2. Average monthly maximum temperature recorded in different protected cultivation structures for winter season.

Treatment	Maximum air temperature (°F)				
	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mean
UV stabilized polyethylene film with 60 mesh insect net along with green shade net	31.5	28.5	27	30	29.25
UV stabilized polyethylene film with 60 mesh insect net	34	31	29	32	31.50
60 mesh insect net	30	27	25.5	28.5	27.75
Open (control)	29	26	24.4	27.5	26.73

Table 3. Average monthly mean relative humidity (%) recorded in different protected cultivation structure during winter season.

Treatment	Monthly mean relative humidity (%)				
	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mean
UV stabilized polyethylene film with 60 mesh insect net along with green shade net	56	52.5	48.5	40	49.25
UV stabilized polyethylene film with 60 mesh insect net	55	52	47.5	38.5	48.25
60 mesh insect net	54.5	51.5	47	38	47.75
Open (control)	53	50	46	37	46.50

2.4. Data Recorded

Data were collected on seed germination (%), seedling mortality (%), seedling height (at 15 days, 20 days, 25 days, 30 days), no. of leaves at (at 15 days, 20 days, 25 days, 30 days), insect infestation (%) (at 15 days, 20 days, 25 days, 30 days), from 5 randomly selected seedling from each of replication.

2.5. Statistical Analysis

The recorded data for different characters were analyzed statistically using MSTAT-C program to find out the variation among the different genotypes by F-test. Treatment means were compared using Duncan's Multiple Range Test (DMRT) and standard error and coefficient of variation (CV %) were also estimated for each character.

3. Results and Discussion

3.1. Effect of Vegetables Crops

The data presented in **Table 4** depicted that different vegetables [tomato (V1), brinjal (V2), capsicum (V3), broccoli (V4)] showed significant effect on performance of growth development under different shading treatments [1) UV stabilized polyethylene film with 60 mesh insect net along with green shade net (T1); 2) UV stabilized polyethylene film with 60 mesh insect net (T2); 3) 60 mesh insect net (T3) and 4) Open field (control) (T4)].

Brinjal (V2) resulted the maximum seed germination (93.58%) compared to tomato (91.83%), broccoli (91.08%), while the lowest germination was observed in capsicum (88.33%). In case of seedling mortality during the 30 days, the lowest mortality was observed in brinjal (5.58%), followed by tomato (6.58%), while the highest mortality was observed in capsicum (9.08%). It might be due to susceptible to pest and disease. The tallest seedlings were produced in capsicum at 15 days (10.1 cm), 20 days (12.4 cm), 25 days (14.53 cm), 30 days (17.7 cm) of seedling age, while the shortest seedlings were observed in brinjal at 15 days (9.4 cm), 20 days (11.31 cm), 25 days (13.83 cm) and 30 days (16.65 cm). It might be due to slow growth of brinjal seedling.

The maximum leaves were produced in capsicum at 15 days (2.86), 20 days (3.96), 25 days (3.99), 30 days (4.71), while the minimum leaves were observed in broccoli at 15 days (2.46), 20 days (3.01), 25 days (3.02) and 30 days (3.36). It might be due to slow growth of leaves. The minimum insect infestation was observed in broccoli seedling at 15 days (2.00%), 20 days (4.33%), 25 days (6.17%), 30 days (49.42%) and the maximum insect infestation was observed in brinjal at 15 days (4.94%), 20 days (6.58%), 30 days (13.20%), while at 25 days, it maximum in tomato (9.17%). It might be due to prone to insect (**Figure 1**).

3.2. Effect of Different Shading Treatments

The results revealed that among the different shading treatments [1) UV stabi-

lized polyethylene film with 60 mesh insect net along with green shade net (T1); 2) UV stabilized polyethylene film with 60 mesh insect net (T2); 3) 60 mesh insect net (T3) and 4) Open field (control) (T4)]. The shading treatment T1 resulted the maximum seed germination (94.83%) closely followed by T2 (91.45%), while the lowest germination was observed in control treatment T4 (84.58%) (Figure 2). In case of seedling mortality during the 30 days, the lowest mortality was observed in T1 (3.33%), closely followed by T2 (5.33%), while the highest mortality was observed in T4 (12.33%) (Figure 3). It might be due to open condition of the seedling producing area. The tallest seedlings were produced by T1 at 15 days (11.13 cm), 20 days (13.21 cm), 25 days (15.73 cm), 30 days (18.68 cm) of seedling age, while the shortest seedlings were observed in T4 condition at 15 days (8.28 cm), 20 days (10.16 cm), 25 days (12.43 cm) and 30 days (15.58 cm). It might be due to slow growth of seedlings in open condition (Table 5).

Table 4. Effect of vegetables crops on seed germination, seedling height, seedling mortality and insect infestation.

(a)

Crops	Seed germination (%)	Seedling mortality (%)	Seedling height at			
			15 days (cm)	20 days (cm)	25 days (cm)	30 days (cm)
Tomato (V1)	91.83 b	6.58 c	9.8 b	11.78 ab	14.23 ab	17.4 a
Brinjal (V2)	93.58 a	5.58 d	9.4 c	11.31 b	13.83 b	16.65 b
Capsicum (V3)	88.33 c	9.08 a	10.1 a	12.08 a	14.53 a	17.7 a
Broccoli (V4)	91.08 b	7.33 b	9.6 bc	11.51 b	14.03 b	16.85 b
Level of sig.	***	***	***	*	**	***
(CV%)	1.85	8.21	3.62	5.40	3.42	2.82

Level of sig. = *** = 0.1%; ** = 1%; * = 5%.

(b)

Crops	No. of leaves at			
	15 days	20 days	25 days	30 days
Tomato (V1)	2.56 b	3.66 b	3.69 b	4.41b
Brinjal (V2)	2.56 b	3.66 b	3.69 b	4.41b
Capsicum (V3)	2.86 a	3.96 a	3.99 a	4.71a
Broccoli (V4)	2.46 b	3.01 c	3.02 c	3.36c
Level of significance	***	***	***	***
(CV%)	7.87	0.82	6.52	4.87

Level of sig. = *** = 0.1%; ** = 1%; * = 5%; CV: coefficient of variation.

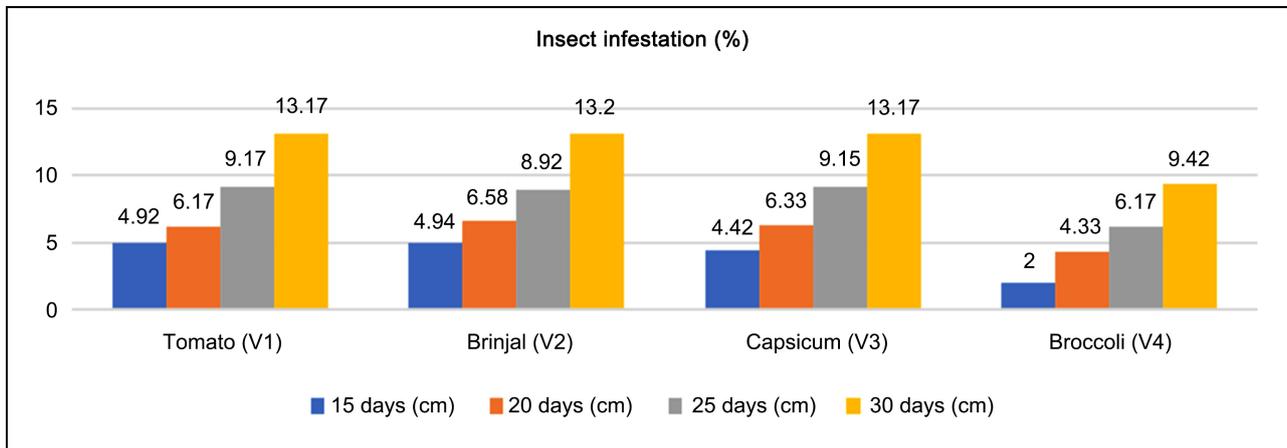


Figure 1. Effect of vegetables crops on insect infestation (%).

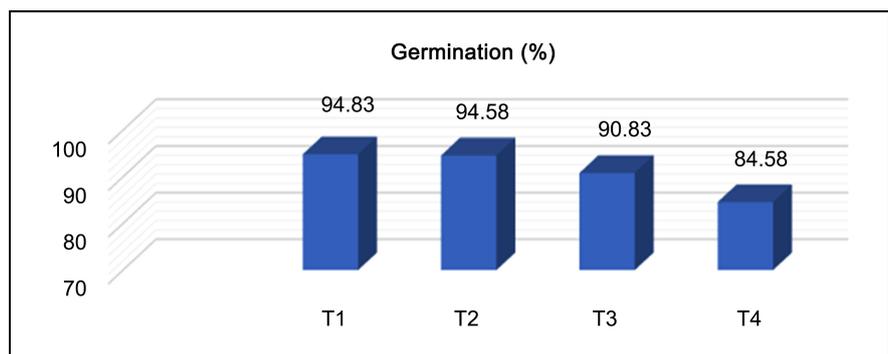


Figure 2. Effect of different shading treatments on seed germination.

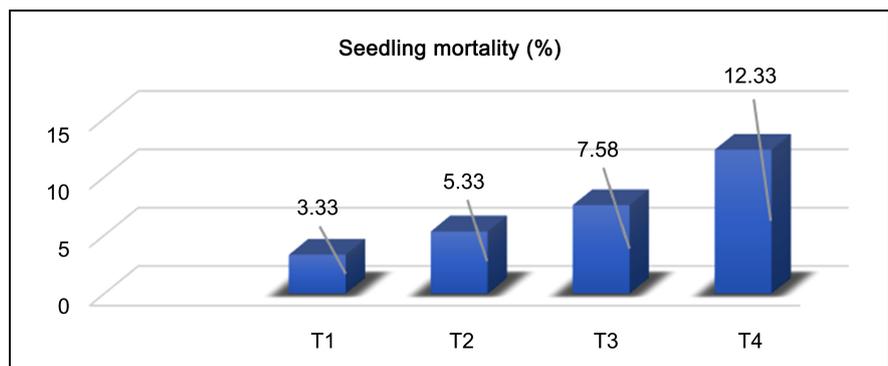


Figure 3. Effect of different shading treatments on seedling mortality.

The maximum no. of leaves was produced in T2 at 15 days (3.08), 20 days (3.93), 25 days (3.89), 30 days (4.81), while the minimum no. of leaves were observed in T4 at 15 days (2.08), 20 days (3.11), 25 days (3.03) and 30 days (3.81). It might be due to less production of leaves. The minimum insect infestation was observed in T1 at 15 days (0.65%), 20 days (1.17%) and in T2 it was observed at 25 days (2.42%), 30 days (4.92%) and the maximum insect infestation was observed in T4 at 15 days (13.83%), 20 days (19.33%), 30 days (23.63%), 25 days (31.92%). It might be due to open condition which favors insect for infestation.

Table 5. Effect of different shading treatments on seed germination, seedling mortality, seedling height and insect infestation.

(a)

Crops	Seedling height at			
	15 days	20 days	25 days	30 days
T1	11.13 a	13.21 a	15.73 a	18.68 a
T2	10.18 b	12.21 b	15.03 b	17.73b
T3	9.33 c	11.11 c	13.43 c	16.63 c
T4	8.28 d	10.16 d	12.43 d	15.58 d
Level of sig.	***	***	***	***
CV	3.2	5.40	3.42	2.82

Level of sig. = *** = 0.1%; ** = 1%; * = 5%; T1: UV stabilized polyethylene film with 60 mesh insect net along with green shade net; T2: UV stabilized polyethylene film with 60 mesh insect net; T3: 60 mesh insect net; T4: Open field (control).

(b)

Crops	No. of leaves at				Insect infestation (%)			
	15 days	20 days	25 days	30 days	15 days	20 days	25 days	30 days
T1	2.88 b	3.68 b	3.69 b	4.21 b	0.65 b	1.17 b	2.92 c	5.17 c
T2	3.08 a	3.93 a	3.89 a	4.81 a	0.67 b	1.25 b	2.42 c	4.92 c
T3	2.38 c	3.56 c	3.49 c	4.06 b	1.08 b	1.67 b	4.42 b	6.92 b
T4	2.08 d	3.11 d	3.32 c	3.81 c	13.83 a	19.33 a	23.67 a	31.92 a
Level of sig.	***	***	***	***	***	***	***	***
CV (%)	7.87	0.82	6.52	4.87	18.08	17.16	12.26	8.38

Level of sig. = *** = 0.1%; ** = 1%; * = 5%; T1: UV stabilized polyethylene film with 60 mesh insect net along with green shade net; T2: UV stabilized polyethylene film with 60 mesh insect net; T3: 60 mesh insect net; T4: Open field (control).

3.3. Effect of Interaction of Different Vegetables and Shading Treatments

The maximum seed germination (93.58%) was observed in V2T1 compared to V1T2, V4T1 (95.83%), while the lowest germination was observed in V3T4 (81.83%). In case of seedling mortality during the 30 days, lowest mortality was observed in V2T1 (2.08%), followed by V1T1, V4T1 (3.08%), while the highest mortality was observed in V3T4 (15.08%). It might be due to susceptible to pest and disease. The tallest seedlings were produced in V3T1 at 15 days (11.50 cm), 20 days (13.73 cm), 25 days (16.15 cm), 30 days (19.25 cm) followed by V1T1 at 15 days (11.20 cm), 20 days (13.43 cm), 25 days (15.85 cm), 30 days (18.95 cm) while the shortest seedlings were observed in V2T4 at 15 days (8.00 cm), 20 days (9.93 cm), 25 days (12.15 cm) and 30 days (15.15 cm). Seedling growth was slow due to open condition (Table 6).

Table 6. Interaction effect of different vegetables and shading treatments.

(a)

Crops	Germination (%)	Seedling mortality (%)	Seedling height at			
			15 days	20 days	25 days	30 days
V1T1	94.83 a-c	3.08 i	11.20 ab	13.43 ab	15.85 ab	18.95 ab
V1T2	95.83 ab	5.08 g	10.30 de	12.33 c-e	15.15 b-d	18.05 cd
V1T3	91.83 def	6.08 f	9.40 g-i	11.23 f-i	13.45 ef	16.85 e-g
V1T4	84.83 h	12.08 b	8.30 kl	10.13 j	12.45 gh	15.75 h-j
V2T1	95.83 ab	2.08 j	10.80 b-d	12.73 a-d	15.35 a-d	18.15 b-d
V2T2	96.83 a	4.08 h	9.80 e-g	11.83 d-g	14.65 d	17.15 ef
V2T3	93.83 b-d	6.08 f	9.00 ij	10.73 h-j	13.15 e-g	16.15 g-i
V2T4	87.83 g	10.08 c	8.00 l	9.93 j	12.15 h	15.15 j
V3T1	92.83 c-e	5.08 g	11.50 a	13.73 a	16.15 a	19.25 a
V3T2	90.83 ef	7.08 e	10.60 cd	12.63 b-d	15.45 a-d	18.33 bc
V3T3	87.83 g	9.08 d	9.70 f-h	11.53 e-h	13.75 e	17.15 ef
V3T4	81.83 i	15.08 a	8.60 jk	10.43 ij	12.75f -h	16.05 g-i
V4T1	95.83 ab	3.08 i	11.00 a-c	12.93 a-c	15.55 a-c	18.35 bc
V4T2	94.83 a-c	5.08 g	10.00 ef	12.03 c-f	14.85 cd	17.35 de
V4T3	89.83 fg	9.08 d	9.20 hi	10.93 g-j	13.35 ef	16.35 f-h
V4T4	83.83 hi	12.08 b	8.20 kl	10.13 j	12.35 gh	15.35 ij
Level of sig.	-	***	-	-	-	-
CV (%)	1.85	8.21	3.62	5.40	3.42	2.82

Level of sig. = *** = 0.1%; ** = 1%; * = 5%; V1: Tomato, V2: brinjal, V3: capsicum, V4: broccoli; T1: UV stabilized polyethylene film with 60 mesh insect net along with green shade net; T2: UV stabilized polyethylene film with 60 mesh insect net; T3: 60 mesh insect net; T4: Open field (control).

(b)

Crops	No. of leaves at				Insect infestation (%)			
	15 days	20 days	25 days	30 days	15 days	20 days	25 days	30 days
V1T1	2.83 b-d	3.73 d	3.77 b-d	4.33 b-d	0.67 d	0.67 d	3.17 ef	5.17 de
V1T2	3.03 a-c	4.00 b	3.97 ab	5.03 a	0.67 d	0.67 d	2.17 f	5.17 de
V1T3	2.33 ef	3.63 e	3.57 c-e	4.23 cd	1.00 d	1.00d	4.17 de	7.17 c
V1T4	2.03 fg	3.23 h	3.47 d-f	4.03 de	17.30 a	22.30 a	27.15 a	35.15 a
V2T1	2.83 b-d	3.73 d	3.77 b-d	4.33 b-d	0.67 d	1.33 d	2.17 f	5.17 de
V2T2	3.03 a-c	4.01 b	3.97 ab	5.03 a	0.67 d	2.33 d	3.17 ef	5.17 de
V2T3	2.33 ef	3.63 e	3.57 c-e	4.23 cd	1.00 d	2.33 d	5.17 d	7.17 c
V2T4	2.03 fg	3.23 h	3.47 d-f	4.03 de	15.33 b	20.33 b	25.17 b	35.17 a
V3T1	3.13 ab	4.03 b	4.07 ab	4.63 b	0.67 d	1.33 d	3.17 ef	5.17 de
V3T2	3.33 a	4.33 a	4.27 a	5.33 a	0.67 d	0.67 d	2.17 f	5.17 de
V3T3	2.63 de	3.93 c	3.87 bc	4.53 bc	1.00 d	1.00 d	4.17 de	7.17 c
V3T4	2.33 ef	3.53 f	3.77 b-d	4.33 dcd	17.33 a	22.33 a	27.17 a	35.17 a
V4T1	2.73 cd	3.23 h	3.17 fg	3.53 fg	0.67 d	1.33 d	3.17 ef	5.17 de
V4T2	2.93 b-d	3.33 g	3.37 ef	3.83 ef	0.67 d	1.33 d	2.17 f	4.17 e
V4T3	2.23 fg	3.03 i	2.97 g	3.23 g	1.33 d	2.33 d	4.17 de	6.17 cd
V4T4	1.93 g	2.43 j	2.57 h	2.83 h	5.33 c	12.33 c	15.17 c	22.17 b
Sig Level	-	***	-	-	***	***	***	***
CV (%)	7.87	0.82	6.52	4.87	18.08	17.16	12.26	8.38

Level of sig. = *** = 0.1%; ** = 1%; * = 5%; V1: Tomato, V2: brinjal, V3: capsicum, V4: broccoli; T1: UV stabilized polyethylene film with 60 mesh insect net along with green shade net; T2: UV stabilized polyethylene film with 60 mesh insect net; T3: 60 mesh insect net; T4: Open field (control).

The maximum no. of leaves was produced in V3T2 at 15 days (33.33), 20 days (4.33), 25 days (4.27), 30 days (5.33), followed by V3T1 at 15 days (3.13), 20 days (4.03), 25 days (4.07), 30 days (4.63), while the minimum no. of leaves were observed in V4T4 at 15 days (1.93), 20 days (2.43), 25 days (2.57) and 30 days (2.83). It might be due to less production of leaves at open condition. The minimum insect infestation was observed in V1T1, V1T2, V2T1, V2T2, V3T1, V3T2, V4T1, V4T2 (0.67% at 15 days and 20 days), while 2.17% was at 25 days and 4.17% at 30 days and the maximum insect infestation was observed in V3T4 at 15 days (17.33%), 20 days (22.33%), 30 days (27.17%), 25 days (35.17%). It might be due to open condition which favors insect for infestation.

4. Conclusion

Brinjal (V2) resulted in the maximum seed germination (93.58%) with the lowest mortality (5.58%), in case of shading treatment, UV stabilized polyethylene film with 60 mesh insect net along with green shade net (T1) exhibited the maximum seed germination (94.83%) with lower mortality (3.33%). In case of combined effect, maximum seed germination (93.58%) and the lowest mortality (2.08%) were observed in V2T1. The tallest seedlings were produced in V3T1 at every growth stage (15 days, 20 days, 25 days, 30 days). The maximum no. of leaves was produced in V3T2. The minimum insect infestation was observed in V1T1, V1T2, V2T1, V2T2, V3T1, V3T2, V4T1, V4T2 (0.67% at 15 days and 20 days).

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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